

Applying GIS in Analysing Black Spot Areas in Penang, Malaysia

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Abstract This study aims to analyze fatal accident rate involving all vehicle types in the North East District of Penang. It covers fatal accident data within the duration of three years from 2011 till 2013. The primary objective is to analyze the spatial pattern and fatal accident black spot areas using Geographic Information System (GIS) application. Average Nearest Neighbor (ANN) tool is used to analyze fatal accident spatial pattern, while Kernel Density Estimation (KDE) method is utilized for fatal accident analysis. The Fatal Accident rates in 2011, 2012 and 2013 were the highest with each accounted up to 90, 88 and 91 cases. The result of ANN shows that the fatal accident pattern for 2011, 2012 and 2013 is clustered with null hypothesis rejected. The KDE analysis result shows that most fatal accident black spot areas happened at main road areas or segments.

Keywords: Fatal accident, GIS, spatial pattern, black spot, Kernel

Abstrak Penelitian ini bertujuan untuk menganalisis tingkat kecelakaan fatal yang melibatkan semua jenis kendaraan di Kabupaten Timur Laut Penang. Ini mencakupi data kecelakaan fatal dalam tiga tahun dari 2011 hingga 2013. Tujuan utamanya adalah untuk menganalisis pola ruangan dan area titik hitam kecelakaan menggunakan aplikasi Sistem Informasi Geografis (SIG). Average Nearest Neighbor (ANN) digunakan untuk menganalisis pola spasial dari kecelakaan fatal, sementara Kernel Density Estimation (KDE) metode digunakan untuk analisis kecelakaan fatal. Tingkat kematian pada tahun 2011, 2012 dan 2013 adalah yang tertinggi dengan masing-masing berkontribusi hingga 90, 88 dan 91 kasus. Hasil ANN menunjukkan bahwa pola kecelakaan fatal untuk 2011, 2012 dan 2013 dikelompokkan dengan menolak "hipotesis nol". Hasil analisis KDE menunjukkan bahwa lokasi utama kecelakaan fatal terjadi di jalan atau segmen utama.

Kata kunci: Kecelakaan fatal, GIS, pola spasial, titik hitam, Kernel

1. Introduction

Generally, urbanisation involves the shift in population from rural to urban settlements (McGranahan & Satterthwaite, 2014). In Malaysia, urbanization refers to the gazetted area and the criteria used in 1970, 1980, 1991 and 2000 Population Census (Masron et al., 2012). The area gazetted as urban areas must have a population of 10,000 and more and gazetted areas with their adjoining built-up areas and the combination of both areas have a total population of 10,000 or more when the Population Census 2000 was conducted (Department of Statistics, 1995 & 2001). According to the Global Road Safety Report, it is stated that there are more than 1.2 million victims of accidents every year, and nearly 50 million people are injured on roads (WHO, 2009). Based on the statement by Masron et al. (2012), Department of Statistics, 1995 & 2001 and WHO (2009), it gives an idea that the higher the number of people, the higher the number of accident cases. Meanwhile, Road Safety Annual Report 2014

shows that the success in reducing road accidents at the global level is still low, although there is an increase in world mobility which is 0.6 percent between 2011 and 2012 (OECD, 2014). Analyzing road accidents is a complex process as the researches are from various backgrounds, including engineering, geography, as well as human behaviors (Sabel et al., 2005).

However, the main influencing factors can be classified into three categories, which are road engineering and traffic conditions, vehicle features and capacities, as well as drivers' behaviors and performance. Various improvements have been made, and steps are taken to reduce the number of road accidents, particularly in the aspects of better road safety and safer vehicle design, but the most significant elements in overcoming this problem are the behavior and performance of the drivers (Clinton & John, 2013).

The study finds that traffic engineering and road network feature operations are the background and context that need to be taken into consideration in the aspects of road safety (Brockenbrough, 2009). Elvik et al. (2009) also find that in a road engineering global study, the best safety priorities include separating traffic on both directions according to the types of vehicles, having better junction design, creating safety monitoring and improving black spot areas, as well as traffic signage along the roads.

Moreover, in examining the Road Accident Theory,

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